# NASA/TM-2000-209891, Vol. 170



# Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Andrea Papagno, Editors

# Volume 170 BOREAS TE-12 Incoming PAR Through the Forest Canopy Data

E.A. Walter-Shea and M.A. Mesarch

National Aeronautics and Space Administration

**Goddard Space Flight Center** Greenbelt, Maryland 20771

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Elizabeth A. Walter-Shea and Mark A. Mesarch University of Nebraska-Lincoln

National Aeronautics and Space Administration

**Goddard Space Flight Center** Greenbelt, Maryland 20771

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# **BOREAS TE-12 Incoming PAR Through the Forest Canopy Data**

Elizabeth A. Walter-Shea, Mark A. Mesarch

# Summary

The BOREAS TE-12 team collected PAR data sets in support of its efforts to characterize and interpret information on shoot geometry, leaf optical properties, leaf water potential, and leaf gas exchange. The data were collected at the SSA-OBS site from 04-Jul-1996 to 25-Jul-1996. The data are stored in tabular ASCII files.

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#### 1. Data Set Overview

#### 1.1 Data Set Identification

BOREAS TE-12 Incoming PAR Through the Forest Canopy Data

#### 1.2 Data Set Introduction

The Terrestrial Ecology (TE)-12 team took measurements of incoming photosynthetically active radiation (PAR) as part of the BOReal Ecosystem-Atmosphere Study (BOREAS) at the Old Black Spruce (OBS) site in the Southern Study Area (SSA) from 04-Jul-1996 to 25-Jul-1996. PAR, in units of micro Einsteins per meter squared per second, from 0.4 to 0.7 microns, was measured in an array below the tree canopy, but above the understory. Ten LI-COR quantum sensors measured PAR, and minute averages are reported.

#### 1.3 Objectives/Purpose

The objective of this research was to characterize the duration and magnitude of sun flecks under a boreal forest canopy.

#### 1.4 Summary of Parameters

Minute averages of PAR, in units of micro Einstein per meter squared per minute.

#### 1.5 Discussion

TE-12 took measurements of incoming PAR at SSA-OBS from 04-Jul-1996 to 25-Jul-1996. PAR, in units of micro Einsteins per meter squared per second, from 0.4 to 0.7 microns, was measured in an array below the tree canopy, but above the understory. Ten LI-COR quantum sensors measured PAR, and minute averages are reported.

#### 1.6 Related Data Sets

TE-12 Shoot Geometry Data

TE-12 Leaf Gas Exchange Data

# 2. Investigator(s)

#### 2.1 Investigator(s) Name and Title

Elizabeth A. Walter-Shea, Assoc. Professor

#### 2.2 Title of Investigation

Radiation and Gas Exchange of Canopy Elements in a Boreal Forest

#### 2.3 Contact Information

#### Contact 1:

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#### Contact 2:

Elizabeth A. Walter-Shea University of Nebraska 246 LW Chase Hall Lincoln, NE 68583-0728 (402) 472-1553 (402) 472-6614 (fax) ewalter-shea1@unl.edu

#### Contact 3:

Andrea Papagno Raytheon ITSS NASA GSFC Code 923 Greenbelt, MD 20771 (301) 286-3134 (301) 286-0239 (fax) Andrea.Papagno@gsfc.nasa.gov

#### 3. Theory of Measurements

Fluxes need to be measured at understory levels to relate to environmental and state variables and explain the stand scale fluxes. At the understory level, upper canopy elements shade the understory partially, creating sun flecks. These sun flecks fluctuate over time, both spatially and in intensity. An array of hemisphere sensors was placed above the understory to measure a represented area of transmitted PAR. The time frame of the measurements, 1-minute averages, provided a time scale representative of a plant's photosynthetic processes' reaction time.

# 4. Equipment

#### 4.1 Sensor/Instrument Description

A LI-COR Quantum Sensor (LI-190SA) was used to detect sun flecks. A silicon photo diode with an enhanced response in the visible wavelengths was used to measure PAR, from 0.4 to 0.7 microns. A visible bandpass interference filter, in combination with color glass filters, was mounted in a cosine corrected head. Error calculations indicated that under sun-and-sky radiation, and under various natural or artificial light sources, the relative measurement errors are less than 5.0%. Therefore, this sensor can be used within or inverted over canopies and in greenhouses, controlled growth chambers, and confined laboratory conditions. Generally, this instrument measures hemispherical incoming radiation; however, when placed within a canopy, the instrument acts as a point source detector.

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The table below describes the directions and distances from the central point for sensor.

Sensor serial number	Direction	Distance (m)
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
Q9123	Southeast	12
Q9022	South	12
Q7433	South-Southwest	1.7
Q7434	Southwest	5
Q10890	West	12
Q89085	Northwest	4.5

#### 4.1.1 Collection Environment

Measurements were made onsite at the SSA-OBS site.

#### 4.1.2 Source/Platform

Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole, 0.6 m above the sphagnum surface. Once the wood block was attached to the pole, the leveling screws on the fixture were used to level the fixture holding the quantum sensor.

#### 4.1.3 Source/Platform Mission Objectives

None given.

#### 4.1.4 Key Variables

Incoming PAR under a tree canopy.

#### 4.1.5 Principles of Operation

The LI-COR quantum sensor uses a silicon diode to convert sunlight to electrical energy (voltage).

#### 4.1.6 Sensor/Instrument Measurement Geometry

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The table below describes the directions and distances from the central point for sensor.

Sensor serial number	Direction	Distance (m)
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
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Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole 0.6 m above the sphagnum surface. Once the wood block was attached to the pole, the leveling screws on the fixture were used to level the fixture holding the quantum sensor.

#### 4.1.7 Manufacturer of Sensor/Instrument

LI-COR, Inc. Box 4425 Lincoln, NE 68504 (402) 467-3576

#### 4.2 Calibration

#### 4.2.1 Specifications

None given.

#### **4.2.1.1 Tolerance**

None given.

#### 4.2.2 Frequency of Calibration

LI-COR quantum sensors were calibrated at the manufacturer in May 1996.

#### 4.2.3 Other Calibration Information

Calibration coefficients for the sensors were in units of micro Einsteins per meter squared per second per millivolt.

Sensor Number	Serial Number	Coefficient
1	Q9020	-253.54
2	Q9022	-282.05
3	Q7434	-252.00
4	Q9123	-308.31
5	Q15566	-311.21
6	Q15565	-245.64
7	Q89085	-285.45
8	Q10890	-286.44
9	Q7433	-200.00
10	Q2734	-194.55

# 5. Data Acquisition Methods

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The sensors were placed in the array to cover an area of approximately 600 m<sup>2</sup>, which was representative of an area of understory under the canopy. The table below describes the directions and distances from the central point for sensor.

Sensor serial number	<b>Direction</b>	Distance (m)
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
Q9123	Southeast	12
Q9022	South	12
Q7433	South-Southwest	1.7
Q7434	Southwest	5
Q10890	West	12
Q89085	Northwest	4.5

Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole, 0.6 m above the sphagnum surface. Once the wood block was attached to the pole the leveling screws on the fixture were used to level the fixture holding the quantum sensor. Data were measured every 5 seconds and reported as 1-minute averages.

#### 6. Observations

#### 6.1 Data Notes

None given.

#### 6.2 Field Notes

None given.

# 7. Data Description

#### 7.1 Spatial Characteristics

#### 7.1.1 Spatial Coverage

The SSA measurement site and its associated North American Datum of 1983 (NAD83) coordinates are:

• SSA-OBS, site id G8I4T, Lat/Long: 53.98717\_N, 105.11779\_W, Universal Transverse Mercator (UTM) Zone 13, N: 5,982,100.5, E: 492,276.5.

#### 7.1.2 Spatial Coverage Map

Not applicable.

#### 7.1.3 Spatial Resolution

The maximum distance between any two quantum sensors was 27 meters. The entire array covered approximately 600 m<sup>2</sup>.

#### 7.1.4 Projection

Not applicable.

#### 7.1.5 Grid Description

Not applicable.

#### 7.2 Temporal Characteristics

#### 7.2.1 Temporal Coverage

Data were collected at the OBS-SSA site From 04-Jul-1996 to 25-Jul-1996.

#### 7.2.2 Temporal Coverage Map

Not available.

#### 7.2.3 Temporal Resolution

Data were collected on most days from sunrise to sunset (approximately 4 a.m. to 10 p.m. local time). Measurements were made every 5 seconds and reported as 1-minute averages.

#### 7.3 Data Characteristics

#### 7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name

SITE\_NAME

SUB\_SITE

DATE\_OBS

TIME\_OBS

MEAN\_DIR\_DOWN\_PPFD\_SNSR1

MEAN\_DIR\_DOWN\_PPFD\_SNSR2

MEAN\_DIR\_DOWN\_PPFD\_SNSR3

MEAN\_DIR\_DOWN\_PPFD\_SNSR4

MEAN\_DIR\_DOWN\_PPFD\_SNSR5

MEAN\_DIR\_DOWN\_PPFD\_SNSR5

MEAN\_DIR\_DOWN\_PPFD\_SNSR6

MEAN\_DIR\_DOWN\_PPFD\_SNSR7

MEAN\_DIR\_DOWN\_PPFD\_SNSR7

MEAN\_DIR\_DOWN\_PPFD\_SNSR9
MEAN\_DIR\_DOWN\_PPFD\_SNSR10
CRTFCN\_CODE
REVISION\_DATE

# 7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS TIME_OBS	The date on which the data were collected. The Greenwich Mean Time (GMT) when the data were collected.
MEAN_DIR_DOWN_PPFD_SNSR1	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 1.
MEAN_DIR_DOWN_PPFD_SNSR2	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 2.
MEAN_DIR_DOWN_PPFD_SNSR3	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 3.
MEAN_DIR_DOWN_PPFD_SNSR4	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 4.
MEAN_DIR_DOWN_PPFD_SNSR5	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 5.
MEAN_DIR_DOWN_PPFD_SNSR6	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 6.
MEAN_DIR_DOWN_PPFD_SNSR7	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 7.

MEAN\_DIR\_DOWN\_PPFD\_SNSR8 The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 8. MEAN DIR DOWN PPFD SNSR9 The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 9. MEAN DIR DOWN PPFD SNSR10 The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 10. The BOREAS certification level of the data. CRTFCN\_CODE Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). The most recent date when the information in the REVISION\_DATE referenced data base table record was revised.

#### 7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
MEAN_DIR_DOWN_PPFD_SNSR1	[microEinsteins][meter^-2][second^-1]
MEAN_DIR_DOWN_PPFD_SNSR2	[microEinsteins][meter^-2][second^-1]
MEAN_DIR_DOWN_PPFD_SNSR3	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR4	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR5	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR6	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR7	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR8	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR9	<pre>[microEinsteins][meter^-2][second^-1]</pre>
MEAN_DIR_DOWN_PPFD_SNSR10	<pre>[microEinsteins][meter^-2][second^-1]</pre>
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

#### 7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source	
SITE_NAME	[BORIS Designation]	
SUB_SITE	[BORIS Designation]	
DATE_OBS	[Human Observer]	
TIME_OBS	[Human Observer]	
MEAN_DIR_DOWN_PPFD_SNSR1	[Laboratory Equipment]	
MEAN_DIR_DOWN_PPFD_SNSR2	[Laboratory Equipment]	
MEAN_DIR_DOWN_PPFD_SNSR3	[Laboratory Equipment]	
MEAN_DIR_DOWN_PPFD_SNSR4	[Laboratory Equipment]	

MEAN_DIR_DOWN_PPFD_SNSR5	[Laboratory Equipment]
MEAN_DIR_DOWN_PPFD_SNSR6	[Laboratory Equipment]
MEAN_DIR_DOWN_PPFD_SNSR7	[Laboratory Equipment]
MEAN_DIR_DOWN_PPFD_SNSR8	[Laboratory Equipment]
MEAN_DIR_DOWN_PPFD_SNSR9	[Laboratory Equipment]
MEAN_DIR_DOWN_PPFD_SNSR10	[Laboratory Equipment]
CRTFCN_CODE	[BORIS Designation]
REVISION_DATE	[BORIS Designation]

#### 7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

CD ROW.	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-OBS-FLXTR	SSA-OBS-FLXTR	None	None	None	None
SUB_SITE	9TE12-PAR01	9TE12-PAR01	None	None	None	None
DATE_OBS	04-JUL-96	25-JUL-96	None	None	None	None
TIME_OBS	0	2358	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR1	0	1769	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR2	-40.21	1562	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR3	0	1640	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR4	0	1801	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR5	0	1670	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR6	0	1888	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR7	0	1659	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR8	0	1728	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR9	0	1685	None	None	None	None
MEAN_DIR_DOWN_PPFD_ SNSR10	0	1356	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	17-MAR-99	17-MAR-99	None	None	None	None

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.

Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the

parameter value, but the value was deemed to be unreliable by the analysis personnel.

Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to

indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.

Data Not Cllctd

-- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

```
Blank -- Indicates that blank spaces are used to denote that type of value.

N/A -- Indicates that the value is not applicable to the respective column.

None -- Indicates that no values of that sort were found in the column.
```

#### 7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

```
SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, MEAN_DIR_DOWN_PPFD_SNSR1,

MEAN_DIR_DOWN_PPFD_SNSR2, MEAN_DIR_DOWN_PPFD_SNSR3, MEAN_DIR_DOWN_PPFD_SNSR4,

MEAN_DIR_DOWN_PPFD_SNSR5, MEAN_DIR_DOWN_PPFD_SNSR6, MEAN_DIR_DOWN_PPFD_SNSR7,

MEAN_DIR_DOWN_PPFD_SNSR8, MEAN_DIR_DOWN_PPFD_SNSR9, MEAN_DIR_DOWN_PPFD_SNSR10,

CRTFCN_CODE, REVISION_DATE

'SSA-OBS-FLXTR', '9TE12-PAR01',04-JUL-96,2212,79.8,87.1,246.0,142.4,212.3,176.4,

84.3,222.6,1111.0,75.2,'CPI',17-MAR-99

'SSA-OBS-FLXTR','9TE12-PAR01',04-JUL-96,2213,71.6,80.5,198.6,113.1,299.6,112.5,

61.91,109.7,1106.0,70.5,'CPI',17-MAR-99
```

# 8. Data Organization

#### 8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data collected at a given site on a given date.

#### 8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

# 9. Data Manipulations

#### 9.1 Formulae

None.

#### 9.1.1 Derivation Techniques and Algorithms

Not applicable.

#### 9.2 Data Processing Sequence

None given.

#### 9.2.1 Processing Steps

None given.

#### 9.2.2 Processing Changes

None given.

#### 9.3 Calculations

#### 9.3.1 Special Corrections/Adjustments

None given.

#### 9.3.2 Calculated Variables

None given.

#### 9.4 Graphs and Plots

None given.

#### 10. Errors

#### 10.1 Sources of Error

The manufacturer estimates that the LI-COR quantum sensor will measure within +/- 5.0 percent relative error of the true incoming PAR.

#### **10.2 Quality Assessment**

#### 10.2.1 Data Validation by Source

None given.

#### 10.2.2 Confidence Level/Accuracy Judgment

None given.

#### **10.2.3 Measurement Error for Parameters**

None given.

#### 10.2.4 Additional Quality Assessments

None given.

#### 10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

#### 11. Notes

#### 11.1 Limitations of the Data

None given.

#### 11.2 Known Problems with the Data

None given.

#### 11.3 Usage Guidance

None given.

#### 11.4 Other Relevant Information

None given.

# 12. Application of the Data Set

This data set can be used to study the incoming PAR of the boreal forest.

#### 13. Future Modifications and Plans

None given.

#### 14. Software

#### 14.1 Software Description

None given.

#### 14.2 Software Access

None given.

#### 15. Data Access

The incoming PAR data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

#### **15.1 Contact Information**

For BOREAS data and documentation please contact:

ORNL DAAC User Services Oak Ridge National Laboratory P.O. Box 2008 MS-6407 Oak Ridge, TN 37831-6407 Phone: (423) 241-3952

Fax: (423) 574-4665

E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

#### 15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

#### 15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

#### 15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

# 16. Output Products and Availability

#### **16.1 Tape Products**

None given.

#### 16.2 Film Products

None given.

#### 16.3 Other Products

These data are available on the BOREAS CD-ROM series.

# 17. References

#### 17.1 Platform/Sensor/Instrument/Data Processing Documentation

LI-COR Radiation Sensors. 1991. Pub. No. 8609-56. LI-COR, Inc., Lincoln, NE.

#### 17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Ĉurd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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# 17.3 Archive/DBMS Usage Documentation

# 18. Glossary of Terms

None.

# 19. List of Acronyms

ASCII - American Standard Code for Information Interchange

BOREAS - BOReal Ecosystem-Atmosphere Study

BORIS - BOREAS Information System

CD-ROM - Compact Disk-Read-Only Memory

DAAC - Distributed Active Archive Center

DOY - Julian Day of Year
EOS - Earth Observing System

EOSDIS - EOS Data and Information System
GIS - Geographic Information System

GMT - Greenwich Mean Time

GSFC - Goddard Space Flight Center HTML - HyperText Markup Language IFC - Intensive Field Campaign

MIX - Mixed Wood

NAD83 - North American Datum of 1983

NASA - National Aeronautics and Space Administration NOAA - National Oceanic and Atmospheric Administration

NSA - Northern Study Area

OA - Old Aspen

OBS - Old Black Spruce

ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park

PAR - Photosynthetically Active Radiation

RSS - Remote Sensing Science SSA - Southern Study Area TE - Terrestrial Ecology

TF - Tower Flux

URL - Uniform Resource Locator
UTM - Universal Transverse Mercator

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